REINFORCING STEEL FOR CONCRETE
FIELD SECTION 1036

1036.1 SCOPE. To establish procedures for inspecting reinforcing steel for use in portland cement concrete.

1036.2 PROCEDURES. The three methods of inspecting and accepting reinforcing steel are described in the following paragraphs.

1036.2.1 Mill Test Reports and Sampling.

1036.2.1.1 Steel offered for inspection is to be sampled and tested in accordance with the applicable AASHTO Specifications as follows:

(a) AASHTO M31, Deformed Billet-Steel Bars for Concrete Reinforcement

(b) AASHTO M42, Rail-Steel Deformed Bars for Concrete Reinforcement.

(c) AASHTO M53, Axle-Steel Deformed Bars for Concrete Reinforcement.

(d) AASHTO M32, Cold Drawn Steel Wire.

(e) AASHTO M55, Welded Steel Wire Fabric.

Material must be inspected as the type or grade for which it is manufactured. If the steel does not meet the requirements of the specification to which it is manufactured, it may not be substituted for the next lower class. For instance, Grade 60 [420] steel failing to meet Grade 60 [420] requirements is not to be substituted for use as Grade 40 [300].

1036.2.1.2 Welded wire fabric for concrete pavement shall be furnished in mats of the size and design shown on the plans. It will be permissible to furnish longitudinally hinged wire fabric for sheets of a required width of 8 ft. [2400 mm] or greater. The hinge shall be made by looping the transverse wires around a longitudinal wire, and shall be capable of developing the full strength of the transverse wire. The hinge shall be located within one foot [300 mm] of the center of the width of the sheet. All steel wire fabric shall be free from dirt, paint, oil, grease, thick rust, and other foreign substances. Thin powdery rust need not be removed.

1036.2.1.3 A mill test report showing complete physical tests is required for all reinforcing steel. The mill test report shall be retained by the shipper of the steel and a copy made available to the inspector upon request. The mill test report for steel bars shall also show the results of complete chemical tests. The mill test report shall be compared against the requirements of the proper AASHTO Specification to insure contract compliance.

1036.2.1.4 When a sample is requested, the steel shall be sampled, submitted to the Central Laboratory for testing with a copy of the mill test report, and documented through SiteManager. Samples shall consist of the following:

REINFORCING STEEL, DOWEL BARS, MECHANICAL BAR SPLICES AND COLD DRAWN WIRE. When requested, a sample of reinforcing steel representing a heat, size, or grade; or cold drawn wire shall consist of four pieces for the steel properties, and/or two pieces for the epoxy coating properties (when required). Mechanical bar splice samples shall have 12 ± 1 inches [300±20 mm] of reinforcing steel extending from each end of the splice. Samples of cold drawn steel wire and reinforcing steel bars shall be of the length shown for the appropriate bar size and test shown in the following table.

BAR SIZE	**Bend Test**	**Tension Test**
Reinforcing Steel and Wire		
#11 Bar and Smaller[#36	28 ± 2"* [680 ± 50 mm]	28 ± 2"[680± 50 mm]
#14 and #18 Bar [#43 and #57]	46 ± 2" *[1170 ± 50 mm]	28 ± 2"[680± 50 mm]
Dowel Bars		
1" and Smaller [25 mm]	28 ± 2"[680 ± 50 mm]	18" to 29"[450to700mm
1 1/4"[32 mm] and Larger	36" ± 2"[900 ± 50 mm]	18"to 29"[450 to700mm

*Use the same length for flexibility of epoxy coating samples.

WELDED WIRE FABRIC. When requested, wire to be sampled for Central Laboratory testing is to be field measured for size prior to sampling. Each wire across the width of fabric is to be measured. The manufacturer may use over-sized wire in the fabrication of welded wire fabric, but no under-sized wire. The size differential shall not exceed one "W" size increment on sizes W8 and smaller and two "W" size increments on sizes larger than W8. "W" sizes referred to are those shown in AASHTO M 32. In all cases where over-sizing exists, the fabric shall be identified and used as that originally ordered or offered for use. Field measurements should be listed in the remarks associated with the Basic Sample Data tab in SiteManager when submitting the sample. A sample of welded wire fabric shall consist of one piece representing the full width of the fabric and not less than 24 in. [600 mm] long, measured in the direction of the longitudinal wires. It will be permissible to cut a sample into sections approximately 3 ft [900 mm] in width, for convenience in shipping to the Central Laboratory. When samples are to be reduced into such sections, the cuts should be made in transverse wires approximately at the midpoint between the two adjacent longitudinal wires.

1036.2.3 Project Inspection and Sampling for PAL. Inspection of PAL material shall be as stated in this section and GS-13.

1036.2.4 SUBSTITUTION OF ASTM A706 STEEL. ASTM A706 steel may be substituted for Grade 40 (300) or Grade 60 (420) provided that the mill certifications indicate that the A706 steel meets all requirements of the AASHTO M31, M42, or M53. Of specific concern is that the tensile strength meets the minimum required. Notify *Construction and Materials* if the substitution is made on PAL material.

1036.3 SAMPLE RECORD. If Central Laboratory samples are obtained, the Laboratory will record the test results in SiteManager. The Basic Sample Data tab shall show all

pertinent information regarding the material including mill order number. Appropriate remarks, as described in General Sec 7 of this Manual, are to be included to clarify conditions of acceptance or rejection.

1036.4 EPOXY COATED REINFORCING STEEL.

1036.4.1 Scope. To establish procedures for inspecting epoxy coated reinforcing steel for use in portland cement concrete.

1036.4.1.1 Epoxy coated reinforcing steel should only be accepted if coated by one of the qualified coating plants designated on PAL. A PAL epoxy coating plant should be inspected once a month when the plant is providing material for MoDOT work. At the time of inspection of the plant the inspector should confirm that the plant is producing to meet MoDOT specifications however, it is not necessary that the production be specifically for MoDOT work.

1036.4.1.2 If a plant proposes to furnish epoxy coated steel and is not on PAL, a request is to be made to *Construction and Materials* for inspection of the plant facilities. Upon satisfactory inspection, the plant will be placed on the PAL.

1036.4.2 Apparatus.

(a) Magnetic gauge, reading range 0-40 mils [0-1000 µm].

(b) Holiday detector, Tinker and Rasor Model M/1 or equivalent

(c) File or knife to remove coating for holiday detector connections

(d) Pictorial surface preparation standard.

1036.4.3 Procedure.

1036.4.3.1 Plant Inspection. Uncoated steel should be from a PAL source. Surface preparation should be checked to insure compliance with SSPC-SP10, near white finish. Periodic checks should be made to insure the temperature recommendations of the epoxy powder manufacturer are being followed and the coating is properly cured. The epoxy powder must be on the qualified list shown in Field Sec FS-1036 Table 1 of this Manual.

1036.4.3.1.1 Coating Film Thickness. Coating film thickness may be checked with a magnetic gauge as soon as the bars have cooled to handling temperature. Readings should be taken on a representative number of bars from the total production. The inspector may vary the number to be tested depending upon plant production and difficulties encountered in the coating process. Two thickness readings should be taken on each side of the bar at three locations to give twelve readings per bar. The average of these readings should be recorded as the coating thickness on the bar tested. The inspector should try to use the smooth area near bar markings whenever possible and hold the gauge firmly on the bar to insure accurate readings. Unusually high or low readings should be checked again and not recorded if gauge error due to surface irregularities is suspected. Readings should be recorded to the nearest 0.1 mil [2.5 µm] and reported to the nearest whole mil [µm]. Thickness determinations on all bars of a given size should be averaged to give the reported thickness for an inspected lot. An inspected lot may be considered as the amount of steel available for inspection at the time an inspection is performed.

1036.4.3.1.2 Continuity. Continuity of coating may be checked on the same bars used for coating thickness determinations. Attach the lead wire of the holiday detector to any location on the bar where the coating has been removed down to bare metal. Pass the wet sponge attached to the inspection lead of the detector over the coated surface. Make at least one pass in each direction along the length of the bar to insure contact on both sides of bars with sharp or rough deformations. Record the number of holidays per bar length. Divide the total per bar by its length in feet [meter] to determine compliance with the maximum allowable of two per foot [7 per meter]. If the coater has an in-line holiday detector, the coated steel should be checked periodically with a portable detector to insure its accuracy.

1036.4.3.1.3 Flexibility. Flexibility of coating tests should be performed as part of a plant inspection.

1036.4.3.1.4 Repairing Bars. Patching should be performed in accordance with the coating manufacturer's instructions and as described in Specification Sec 710.3.3. It is not intended that patching material be used to cover extensive areas left uncoated during the initial coating process. Patching should be done sparingly on sheared or cut ends and damaged areas.

1036.4.3.2 Field Inspection. The procedures described in the preceding paragraphs for coating film thickness and continuity tests apply also to field inspection. Frequency of sampling depends upon the number of different size bars and the quantity presented for inspection in each order. As a guide, select three bundles at random of each bar size from each load. If individual loads cannot be distinguished, every fourth bundle of each size may be selected. Take three bars from each bundle and perform thickness and holiday tests. If results are not within specification limits, double the number of sample bars should be taken. If ten percent or more of the bars tested fail to meet specification requirements, *Construction and Materials* should be notified of the circumstances of the failure. A quick survey of the entire lot consisting of random checks with the magnetic gauge and visual examination of the coating will usually insure the material selected is representative. Once field tests have determined compliance with the holiday and coating thickness requirements, samples for steel properties and flexibility of coating should be taken. Test results are to be documented in SiteManager. Samples for steel properties should be taken in accordance with Specification Sec 1036.2.1 of this manual. Central Laboratory samples for flexibility of coating should consist of one bar of each size in the order cut to the bend test length shown in Sec 1036.2.1.4 of this manual.

1036.4.4 Sample Record.

1036.4.4.1 Plant Inspection. When epoxy coated reinforcing steel is inspected at the coating plant, SiteManager shall be used. The inspector is to show complete information related to the inspection. A material code, 0106XXPAL, is provided to track plant inspections. Include the following for each lot sampled:

(a) Availability of required documentation.

(b) Coating thickness–average of all bars of each size rounded to nearest whole mil [µm].

(c) Holiday test results (less than or in excess of two per foot [7 per meter]).

(g) Brand of coating material.

1036.4.4.2 Field Inspection. When epoxy coated reinforcing steel is inspected at destination, SiteManager shall be used when submitting samples to the Central Laboratory. A separate sample I.D. should be used for each set of samples of each bar size. The inspector is to show complete information including the following for each lot sampled.

(a) Results of field tests for holidays and coating thickness
(b) Bar size.
(c) Grade of steel.
(d) PAL id number.

1036.4.5 Certification.

1036.4.5.1 Regardless of where the epoxy coated steel is sampled and tested, the shipper should make available the following:

(a) Steel manufacturer's certified mill test report showing complete chemical and physical test results.

(b) Epoxy powder manufacturer's certification that the materials supplied the coating applicator conforms to the contract.

(c) Coating applicator's certification certifying that all materials used, the preparation of the bars, coating and curing were done in accordance with the contract and that no bar contains more than 2 holidays per foot [7 per meter].

(d) Coating applicator's specific test results of tests for coating thickness and flexibility of coating.

Typical certifications should be examined for compliance as part of a plant inspection. Method of filing and ability to track documentation of a particular shipment shall be to the satisfaction of the inspector. It is acceptable for a shipper to obtain the documentation listed above (from the manufacturer) at the time it is requested by the inspector if it is obtained in a timely fashion and can reasonably be tracked to the material shipped.